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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/096,858	06/12/1998	PRAVIN K. NARWANKAR	AMAT2571.US/	2295

7590 05/03/2002

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EXAMINER

MAI, ANH D

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 05/03/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/096,858

Applicant(s)

NARWANKAR ET AL.

Examiner

Anh D. Mai

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 14 March 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-9, 11, 12, 14-29, 31 and 33-45 is/are pending in the application.
- 4a) Of the above claim(s) 8, 9, 11, 12 and 33-45 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9, 11, 12, 14-29 and 31 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on March 14, 2002 has been entered.

Amendment

2. the Amendment filed March 14, 2002 is entered as Paper No. 19. Claim 8 was amended; claims 10 and 13 were canceled.

Election/Restrictions

3. Newly submitted (amended) claims 8, 9, 11 and 12 are directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: the newly amended claims are *directed to a method of forming a metal oxide dielectric layer on a substrate by combining metal atoms and reactive (active) atomic species*.

Since applicant has received an action on the merits for the originally presented invention, this invention has been constructively *elected* by original presentation for prosecution on the merits. Accordingly, claims 8, 9, 11 and 12 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

The elected species is "treating the deposited dielectric layer with active atomic species". (See Paper No. 4 and 5).

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Specification

4. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-6, 14, 17, 18 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over DeBoer et al. (U.S. Pub No. 2001/0011740).

DeBoer teaches a method of forming a dielectric layer of a device substantially similar as claimed including:

forming a dielectric layer (102) on a substrate (101);

generating ionized atoms in a first chamber;

flowing the ionized atoms through a conduit coupling the first chamber to a second chamber, wherein the ionized atoms become electrically neutral active atomic species before reaching the second chamber; and

exposing the dielectric layer (102) to the active atomic species in the second chamber;

and

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forming an electrode (106) above the active atomic species exposed dielectric layer. (See Fig. 1A).

Since the process of DeBoer comprises exposing the dielectric layer (102) to an active atomic species generated by remote plasma, thus, the teaching of DeBoer includes: generating ionized atoms in a first chamber (remote plasma); flowing the ionized atoms through a conduit coupling the first chamber to a second chamber, wherein the ionized atoms become electrically neutral active atomic species before reaching the second chamber.

With respect to claim 2, the active atomic species of DeBoer comprises reactive oxygen atoms.

With respect to claim 3, the active atomic species of DeBoer comprises reactive nitrogen atoms.

With respect to claim 4, the dielectric layer (102) of DeBoer comprises a metal-oxide.

With respect to claim 5, the dielectric layer (102) of DeBoer comprises transition metal dielectric.

With respect to claim 6, the dielectric layer (102) of DeBoer comprises Ta₂O₅.

With respect to claim 14, DeBoer teaches a method of annealing a deposited oxide of a device substantially similar as claimed including:

locating a substrate (101) in a first chamber, the substrate (101) having a deposited oxide (102) formed thereon;

generating a plasma comprising ionized oxygen atoms in a second chamber;

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flowing the ionized oxygen atoms from the second chamber into the first chamber through a conduit wherein the ionized oxygen atoms become electrically neutral reactive oxygen atoms while flowing from the second chamber to the first chamber;

exposing the deposited oxide (102) to the reactive oxygen atoms; and

forming an electrode (106) above the active atomic species exposed deposited oxide layer. (See Fig. 1A).

Since the process of DeBoer comprises exposing the dielectric layer (102) to an active atomic species generated by remotely, thus, the teaching of DeBoer includes: generating a plasma comprising ionized oxygen atoms in a second chamber (remote); flowing the ionized oxygen atoms from the second chamber into the first chamber through a conduit wherein the ionized oxygen atoms become electrically neutral reactive neutral oxygen atom while flowing from the second chamber to the first chamber.

With respect to claims 17 and 18, the reactive oxygen atoms of DeBoer are formed by generating a plasma from O_2 or N_2O molecules.

With respect to claim 21, the dielectric layer (102) of DeBoer comprises a metal-oxide.

With respect to claim 22, the dielectric layer (102) of DeBoer comprises transition metal dielectric.

With respect to claim 23, the dielectric layer (102) of DeBoer comprises Ta_2O_5 .

6. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over DeBoer '740 as applied to claim 14 above, and further in view Toshio (JP 04-092423).

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DeBoer teaches all of the features of the claim with the exception of forming the deposited oxide including silicon-oxide.

However, Toshio teaches forming a deposited oxide on a substrate comprising silicon-oxide.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to form the deposited oxide of DeBoer comprising silicon-oxide as taught by Toshio since silicon-oxide is also benefited from the ionized oxygen plasma treatment to enhance water-resistant property. Moreover, silicon oxide is a well known capacitor dielectric.

7. Claims 16 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over DeBoer '740 as applied to claim 14 above, and further in view of Slomowitz (U.S. Patent No. 4,88,088).

With respect to claim 16, DeBoer teach all the features of the claim with the exception of explicitly disclosing that the remote plasma generator (second chamber) is of a microwave applicator cavity.

However, Slomowitz teaches a remote plasma generator comprises a microwave applicator cavity to sustain the reactive atoms (plasma).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to generate the plasma of DeBoer using a microwave applicator cavity generator as taught by Slomowitz to sustain excited reactive atoms during transport to the processing chamber.

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With respect to claim 19, the reactive oxygen atoms of DeBoer are formed by generating a plasma from O₂, remotely.

8. Claims 24, 25, 27 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over DeBoer '740 in view of Slomowitz '088.

DeBoer teaches a method of forming capacitor substantially similar as claimed including:
forming a bottom electrode (104);
depositing a transition metal dielectric (102) on the bottom electrode (104) in a deposition chamber;
generating a plasma comprising ionized oxygen atoms by forming the plasma from an oxygen containing gas in a remote plasma generator chamber;
flowing the ionized oxygen atoms through a conduit coupling the remote plasma generator chamber and the deposition chamber, wherein the ionized atoms become electrically neutral reactive oxygen atoms before reaching the second chamber;
annealing the transition metal dielectric (102) in the deposition chamber by exposing the transition metal dielectric to the reactive oxygen atoms; and
forming a top electrode (106) above the reactive atomic species exposed transition metal dielectric (102). (See Fig. 1A).

Thus, DeBoer is shown to teach all the features of the claim with the exception of explicitly disclosing that the remote plasma generator is of a microwave applicator cavity.

However, Slomowitz teaches a type of remote plasma generator comprises a microwave applicator cavity to sustain ionized reactive atoms (plasma).

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Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to generate the plasma of DeBoer using a microwave applicator cavity generator as taught by Slomowitz to sustain the excited reactive atoms during transport to the annealing chamber.

Regarding the characteristic of the plasma generated remotely, see claims 1 and 14 above.

With respect to claims 25 and 27, the transition metal dielectric (102) of DeBoer is Ta₂O₅ deposited by CVD utilizing a source gas as claimed.

With respect to claim 28, the transition metal dielectric (102) of DeBoer is deposited at a temperature within the claimed range.

9. Claims 26 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over DeBoer '740 and Slomowitz '088 as applied to claim 24 above, and further in view of Hasegawa (U.S. Patent No. 5,677,015).

DeBoer and Slomowitz teach all of the features of the claim with the exception of forming the transition metal dielectric (Ta₂O₅) utilizing TAT-DMAE and N₂O as the source gas.

However, Hasegawa teaches forming the transition metal dielectric (22) utilizing source gases comprising TAT-DMAE and N₂O.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of the invention was made to form the transition metal dielectric (Ta₂O₅) of DeBoer utilizing the source gases as taught by Hasegawa since forming Ta₂O₅ utilizing these gases are well known.

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10. Claims 7 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over DeBoer '740 as applied to claims 1 and 14 above, and further in view of Park et al. (U.S. Patent No. 5,910,218).

DeBoer teaches all the features of the claim with the exception of explicitly disclosing the temperature of the substrate during the plasma anneal.

However, Park teaches the temperature during a plasma annealing (250 to 350 °C) is lower than that of film depositing to prevent recombination of the excited reactive atoms.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to anneal the deposited oxide of DeBoer in reactive oxygen atoms at the temperature as taught by Park to prevent the excited reactive atoms from recombination thus, less effective.

11. Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over DeBoer '740 and Slomowitz '088 as applied to claim 24 above, and further in view of Park et al. (U.S. Patent No. 5,910,218).

DeBoer teaches all the features of the claim with the exception of explicitly disclosing the temperature of the substrate during the plasma anneal.

However, Park teaches the temperature during a plasma annealing (250 to 350 °C) is lower than that of film depositing to prevent recombination of the excited reactive atoms.

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to anneal the deposited oxide of DeBoer in reactive oxygen atoms at the temperature as taught by Park to prevent the excited reactive atoms from recombination thus, less effective.

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Response to Arguments

12. Applicant's arguments with respect to all claims have been considered but are moot in view of the new ground(s) of rejection.

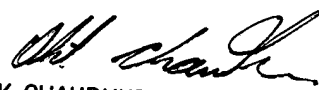
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (703) 305-0575. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703) 306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

A.M
April 23, 2002


OLIK CHAUDHURI
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